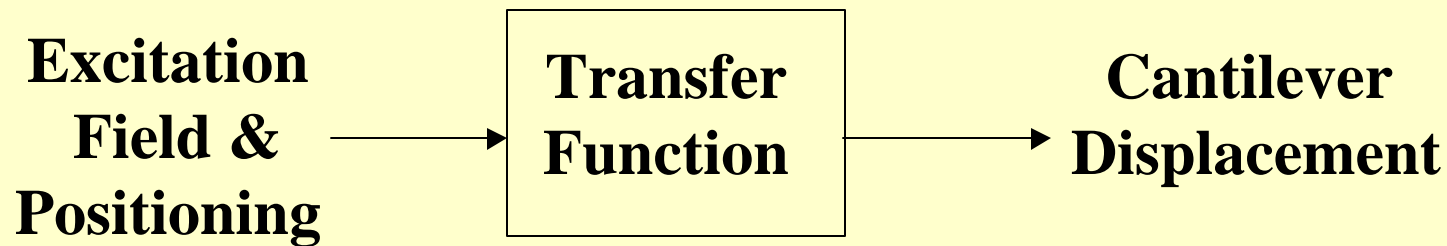# Signal Processing and Control Challenges in MOSAIC
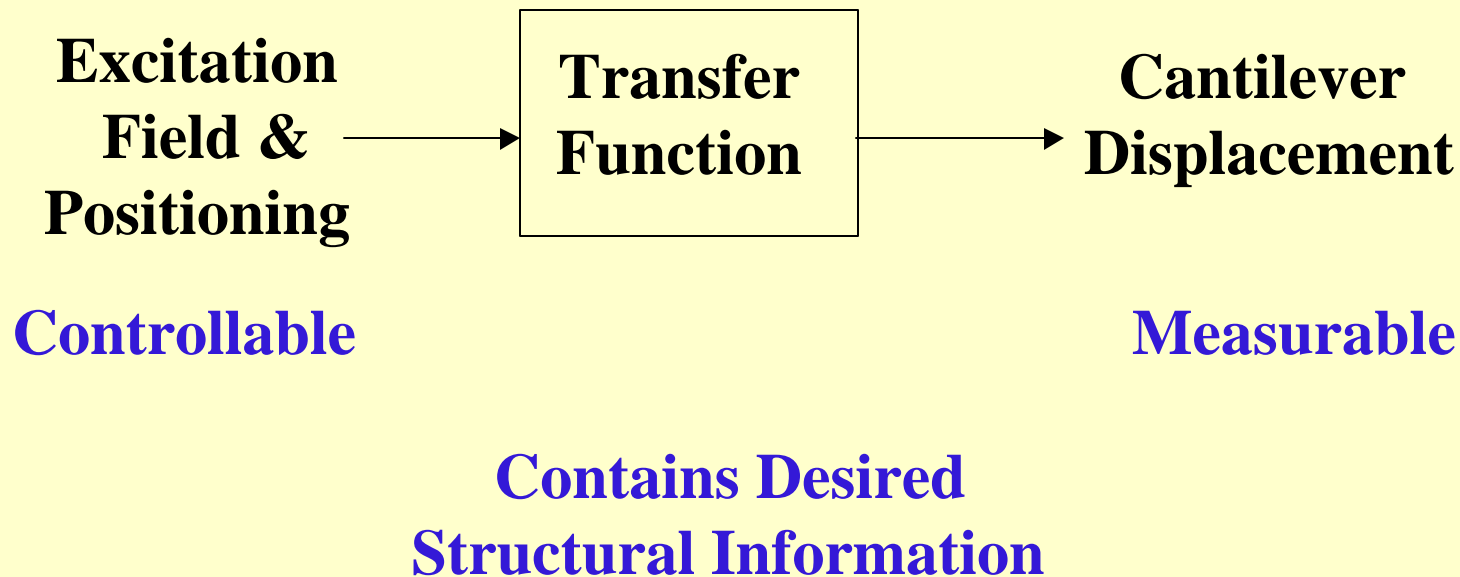
## August 21, 2001

MOSAIC

- MOSAIC goals will require teams including mathematical expertise
  - Signal processing
  - Control science
  - Numerical analysis
  - Special purpose processor architectures

- Past DARPA/DSO programs have achieved major technological advances through teaming of mathematicians with other scientists and practitioners

# A Simplified System Perspective

**Excitation Field & Positioning** → **Transfer Function** → **Cantilever Displacement**

# Simplified System Perspective

**Excitation Field & Positioning** → **Transfer Function** → **Cantilever Displacement**

**Controllable**                    **Measurable**

**Contains Desired Structural Information**

# Simplified System Perspective

**Excitation Field & Positioning** → **Transfer Function** → **Cantilever Displacement**

**Random Quantum Effects**    **Measurement Noise**

**Controllable**    **Measurable**

**Contains Desired Structural Information**
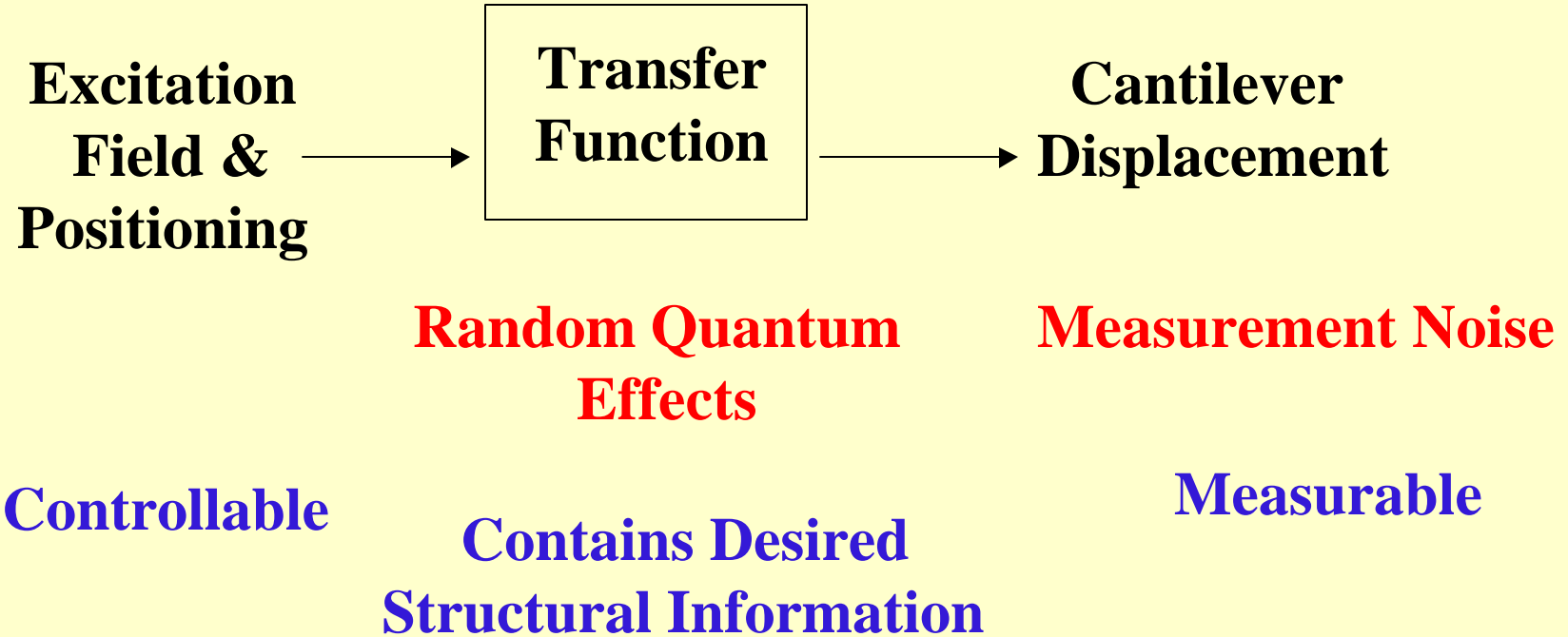
# Potential Signal Processing Contributions

- Characterization of noise sources
- Design of measurement processes
  - Minimize SNR
  - Maximize potential processing gain
- Development of fast image quality metrics (for feedback to measurement process)
- Novel excitation signals (phase coding?)
- Very high-speed algorithms (on specialized architectures)

# Potential Control Aspects

- Nanopositioning; Manipulation of objects under observation

- Strategies that exploit multiple scales of phenomenology and controls

- Feedback from measurement and/or image formation processes to controllable inputs

# Simplified System Perspective

**Excitation Field & Positioning**  →  **Transfer Function**  →  **Cantilever Displacement**

**Controllable**                                    **Measurable**

**Contains Desired Structural Information**